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Response of S-phase to Rapid Annealing

Yana Liang
PhD, University of Birmingham, UK

AISI 316 stainless steelis commonly used in many fields due to its excellent corrosion resistance and good bio-compatibility. However, AISI 316 stainless steel has limitations with regard to low hardness, poor tribological and tribochemical performances. Low temperature plasma nitriding treatment provides an opportunity to significantly improve its hardness and wear resistance without affecting the corrosion resistance by the formation of S-phase. However S-phase is thermodynamically metastable and will decompose into stable phases under certain conditions(Thaiwatthana, Li et al. 2002). Thus, the aim of this study is to investigate the response of S-phase to rapid annealing and to explore the possibility to develop new materials by intentional, controlled decomposition of S-phase. Nitrogen S-phase was formed by low temperature plasma nitriding. Rapid annealing in Gleeble machine was carried on at 440°C, 490°C,540°C and 590°C respectively. The annealed samples were characterised by XRD, SEM and GDS and its properties were evaluated by hardness, electrochemical corrosion and reciprocating wear tests. The results showed that nitrides precipitation began at 540°C for the nitrogen S-phaseafter rapid annealing.Rapid annealing could maintain high nitrogen content at the surface of S-phase. Hence the annealed samples still possessed a relatively high hardness in comparison to untreated samples.No discernible change was observed on the thickness after rapid annealing.Due to the influence of the oxide film covering on nitrogen S-phase, the corrosion resistance deteriorated following rapid annealing. However, little change in the wear ratewas observed, prior to precipitation of nitrides. Although a new material with superior properties did not obtained by this feasibility study, the systematic investigation has advanced scientific understanding on the stability of S-phase.

Biography

I graduated with a master's degree in Material Science from the University of Birmingham in 2015 worked on the stability of S-phase. I am now working towards my PhD in the IMPaCT Doctoral Training Centre under the supervision of Professor Hanshan Dong. My project is focussed on the surface multi-functionalization of carbon fibers using active-screen plasma treatment.The hope is that this work can help to enhance the fibre/matrix interfacial adhesion and the interfacial shear strength (IFSS) between the reinforcing fibres and the matrix in composites

yxl452@student.bham.ac.uk

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